



Nuclear Air Cleaning Handbook

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NUCLEAR AIR CLEANING HANDBOOK

**DESIGN, CONSTRUCTION, AND TESTING OF
HIGH-EFFICIENCY AIR CLEANING SYSTEMS
FOR NUCLEAR APPLICATION**

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FOR THE ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION**

Foreword to Second Edition

This handbook is a revision of ORNL/NSIC-65, *Design, Construction, and Testing of High-Efficiency Air Filtration Systems for Nuclear Application*, which was issued in January 1970. For simplification, the title has been shortened to *Nuclear Air Cleaning Handbook*, and the report has been issued under an ERDA number.

The new edition updates the information of the original volume, corrects some errors that appeared in it, and adds some new material, particularly in the areas of sand filters, deep-bed glass fiber filters, and requirements for plutonium and reprocessing plants. Although A. B. Fuller was unable to contribute directly to this edition, his earlier material on single-filter installation and glove boxes has been largely retained, though rewritten and updated. With this issue, J. E. Kahn of the Union Carbide Corporation Nuclear Division's (UCCND) Engineering staff joins the writing team, contributing particularly in updating the material on glove boxes and writing the sections on sand filters and deep-bed glass fiber filters in Chap. 9. Others who have contributed to this edition include J. C. Little, UCCND Engineering, and a host of reviewers who provided technical evaluation of the draft. Particular thanks are due Dr. M. W. First of the Harvard University School of Public Health, and Mr. Humphrey Gilbert, consultant to the Energy Research and Development Administration (ERDA) and the Nuclear Regulatory Commission (NRC) and former safety engineer with the U.S. Atomic Energy Commission, for their detailed and thorough review of the complete draft. Others who reviewed the complete draft were J. F. Fish, chairman of ANSI Committee N45-8; J. C. Little, UCCND Engineering; J. C. Dempsey, ERDA Division of Nuclear Fuel Cycle and Production; A. B. Fuller, president of Fuller Engineering; and J. T. Collins of NRC. Thanks are also due to the members

of ANSI Committee N45-8 who, perhaps unknowingly, supplied certain data and served as a sounding board for some of the concepts presented in the handbook. We wish to thank the many vendors and ERDA contractors who supplied drawings and photographs used in the book. We also acknowledge the work of Oak Ridge National Laboratory's Technical Publications Department, particularly that of the Composition and Makeup groups, that of R. H. Powell who provided editorial assistance, and especially that of P. J. Patton who edited and coordinated publication of this handbook.

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Oak Ridge, Tennessee
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Foreword to First Edition

This handbook fills a large gap in the literature concerning air cleaning and filtration, the gap that encompasses design, construction, and testing of very high-efficiency air cleaning systems. The project was originally conceived by Mr. Humphrey Gilbert of the USAEC and was sponsored by the Division of Reactor Development and Technology of the USAEC. In preparing for the project we surveyed air-cleaning systems at atomic energy facilities and industrial installations throughout the United States and Canada. We visited AEC production reactors, commercial power reactors, laboratories, radiochemical plants, reactor fuel manufacturers, clean rooms, equipment manufacturers, and one chemical-biological warfare installation. The purposes of these visits were to review current practices in high efficiency air cleaning and to define the problems in operating, maintaining, and controlling contamination release from very high-efficiency air-cleaning systems from experienced people who were dealing with such problems daily. The handbook reflects a consensus of our findings in these travels, in addition to information gleaned from the available literature.

The handbook is addressed primarily to designers and architect-engineers. We frequently observed a lack of communication and feedback from people with problems in the field to designers. Our intention is to bring to the attention of designers of future

systems the kind of problems that an operator faces and what he, the designer, must do to preclude or alleviate them. We have purposely pointed out some poor practices in current design in addition to our recommendations in the hope that such practices will go no further. To give "do's" without "don'ts" may encourage some designers to offer a poor design because he mistakenly believes that "it worked before."

Those who have contributed to the handbook number literally in the hundreds and include those we consulted with and those who have given of their time in reviewing drafts or have supplied specific bits and pieces of information. We take this opportunity to thank the many friends we have made in the course of this project, particularly for their candidness in discussing problems and ways of solving those problems, and for their help in supplying photographs and information. In particular we want to thank Mr. Humphrey Gilbert and I. Craig Roberts of the USAEC for their guidance, W. B. Cottrell of ORNL for his help in getting the book published, T. F. Davis of the USAEC's Division of Technical Information for his assistance in indexing the material, J. H. Waggoner of ORNL for doing the illustrations, and Dr. M. W. First of Harvard University for his meticulous page-by-page review of the draft and suggestions for this final issue.

C. A. Burchsted
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Oak Ridge, Tennessee
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Preface

This handbook is another step in the continuing effort of the Energy Research and Development Administration to ensure the safe operation of nuclear facilities. Gaseous effluents from these facilities are among the more difficult to control, and the AEC, now ERDA, has long carried on an intensive program aimed at their effective control. The record of this program is available in the proceedings of the biennial AEC Air Cleaning Conferences, the first of which was held in 1952 and the fourteenth to be held this year in Idaho. These proceedings and numerous technical reports issued on this topic describe research, development, and experience in specific facilities. In most cases they do not provide general or coordinated guidance for the designer.

The purpose of this handbook is to draw on the wealth of background data available, to digest and

evaluate it, and to provide guidance to the engineer and technologist in the design of future facilities. The book is an update of the earlier ORNL/NSIC-65, issued through the Nuclear Safety Information Center at Oak Ridge National Laboratory, and has been prepared under the direction of the ERDA Division of Nuclear Fuel Cycle and Production. The previous edition has received worldwide recognition as the authoritative text in the field of nuclear air cleaning system design. We believe that publication of this new edition by ERDA is a significant contribution to the technical literature.

Frank P. Baranowski, Director
Division of Nuclear Fuel Cycle
and Production, Energy
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